EARTH RESOURCES ENGINEERING

SECOND CYCLE DEGREE
PROGRAMME/MASTER

BOLOGNA and RAVENNA

ERE is about the conscientious stewardship of finite natural resources, namely minerals, fuels, energy, water, and land.

The focus is on water resources, pollution prevention, energy, resource economics, recycling, waste and bio-waste valorisation, alternative and renewable raw materials, reclamation, and health.

The programme is intended to prepare environmental engineers with firm technical bases and decision-making and leadership potential. It prepares graduates to practice thier profession at an advanced level with a unique exposure to an international environment to better understand the global issues of environmental engineering and circular economy.

Admissions

Read the Call for Applications on the website for information on deadlines, registration rules and scholarship opportunities.

Who might apply: Students who either hold a BSc and/or a MSc,or expect to hold one by the end of the enrolment period, in the following topics:

- Environmental Engineering
- Civil Engineering
- Chemical Engineering
- Petroleum Systems Engineering
- Resources Engineering
- Biotechnology

A B2 level English proficiency is required.

About the programme: Environmental Engineering

All courses and activities are given in English. The master's duration is two years (4 semesters) during which there are core and curriculum courses. The core modules, common for all students, aim at consolidating fundamentals and improving capabilities in the areas of Environmental Engineering,while in the second year students choose a curriculum amongst:

- Earth resources engineering (Bologna);
- Off-shore engineering (Ravenna).

A committee will help students to select the courses to build their own curriculum. In order to obtain the Master Degree (Laurea Magistrale), students must successfully complete all the courses and discuss a final dissertation, for a minimum of 120 Credits (ECTS).

The courses will be organized with in-class teaching activities,practice, design and laboratory activities. The final exam consists in the public discussion of a dissertation (the master thesis).

Even more international

Thanks to Dual Degree agreements, students can obtain two qualifications in two years. The partners are Columbia University (New York, USA); University of Miami (Florida, USA); Université de Liège (Belgium).

Furthermore, international agreements allow students to spend part of their studies abroad (for exams, research, or internships).

About the "Environment, Resources and Circular Economy"option

Material and energy flows through industrial systems and connections between operators within the "industrial ecosystem" will be tackled from a systemic point of view.
Whilst looking at their global impact from the outset, the programme focuses on:

- Earth resources management;
- Sustainable development;
- Resource efficiency and resource savings;
- Rational exploitation of oil and gas reservoirs;
- Water resources;
- Pollution prevention;
- Waste prevention; recycling; waste and bio-waste valorisation;
- Reclamation and health.

Environmental engineering is a subject that will be at the heart of any transition to a circular economy. Equally crucial will be the development of the skill of understanding how individual activities interact within a bigger, interconnected world.

First Year		SSD (scientific sector)	ECTS
Compulsory courses			
81644	LABORATORY ON RENEWABLE RAW MATERIALS AND CIRCULAR ECONOMY		3
73314	ADVANCED HYDROSYSTEMS ENGINEERING M	ICAR/02	9
73315	APPLIED GEOMATICS	ICAR/06	6
73355	BIOTECHNOLOGY FOR THE SUSTAINABLE RECLAMATION OF CONTAMINATED LANDS	CHIM/11	6
70002	ENVIRONMENTAL ENGINEERING RESEARCH A		6
73358	GEOTECHNICS AND GEOLOGY	GEO/05	12
81645	INDUSTRIAL AND ENVIRONMENTAL SAFETY M	ING-IND/25	9
73312	INTRODUCTION TO NUMERICAL METHODS M	MAT/08	6
81944	LABORATORY OF ENVIRONMENTAL ENGINEERING AND ENERGY ECONOMICS		3

Second year		SSD (scientific sector)	ECTS
Compulsory courses			
70003	ENVIRONMENTAL ENGINEERING RESEARCH B		12
Elective courses (36 ECTS)			
73317	INDUSTRIAL ECOLOGY M	ING-IND/25	6
73319	MINERAL PRODUCTION SYSTEMS	ING-IND/28	6
73362	PETROLEUM GEOSYSTEM M	ING-IND/30	6
73356	RESOURCES AND RECYCLING M	ING-IND/29	
78592	WATER ENGINEERING I.C.		12
Elective courses (12 ECTS)			
73371	COMPUTATIONAL MECHANICS	ICAR/08	6
73370	MANAGING ENGINEERING AND CONSTRUCTION PROCESSES	ING-IND/35	6

73372	MATERIALS CHARACTERIZATION AND LABORATORY	ING-IND/22	6
73366	PHOTOCATALITIC PROCESSES AND ENVIRONMENTAL APPLICATIONS	ING-IND/24	3
81509	SUSTAINABLE ROAD INFRASTRUCTURES M		
73529	POLYMER SCIENCE, TECHNOLOGIES AND RECYCLING M	ING-IND/22	6
78965	PUBLIC PROCUREMENT	IUS/10	6
72748	SUSTAINABILITY IN CONSTRUCTION	ICAR/09	6

About the "Off-shore Engineering" option

The programme, entirely delivered in English, is offered thanks to the support of companies in the Ravenna Off-Shore District and of Fondazione Flaminia.

The courses delve into the themes of Off-Shore resources management and exploitation, sustainability of Off-shore processes and impact of Off-shore structures on the environment.

The first year of the programme is delivered in Bologna, while the second year is offered in Ravenna.

Students attending the programme are offered the possibility of carrying out an internship and to develop a Master's thesis in the companies operating in Ravenna.

Off-Shore Engineering

First Year		SSD (scientific sector)	ECTS
Compulsory courses			
81644	LABORATORY ON RENEWABLE RAW MATERIALS AND CIRCULAR ECONOMY		3
73314	ADVANCED HYDROSYSTEMS ENGINEERING M	ICAR/02	9
73315	APPLIED GEOMATICS	ICAR/06	6
73355	BIOTECHNOLOGY FOR THE SUSTAINABLE RECLAMATION OF CONTAMINATED LANDS	CHIM/11	6
70002	ENVIRONMENTAL ENGINEERING RESEARCH A		6
73358	GEOTECHNICS AND GEOLOGY	GEO/05	12
81645	INDUSTRIAL AND ENVIRONMENTAL SAFETY M	ING-IND/25	9
73312	INTRODUCTION TO NUMERICAL METHODS M	MAT/08	6
81944	LABORATORY OF ENVIRONMENTAL ENGINEERING AND ENERGY ECONOMICS		3
Second year		SSD (scientific sector)	ECTS
Compulsory courses			
70003	ENVIRONMENTAL ENGINEERING RESEARCH B		12
Elective courses (36 ECTS)			
78487	BIOREMEDIATION AND EXPLOITATION OF MARINE BIORESOURCES	ICAR/03	
73365	COASTAL ENGINEERING	ICAR/02	6
78640	MONITORING AND POSITIONING IN OFF-SHORE ENGINEERING	ICAR/06	6
78486	OFFSHORE HSE MANAGEMENT	ING-IND/25	6
78481	OFFSHORE O&G EXPLOITATION I.C.		12
Elective courses (12 ECTS)			
78642	CORROSION AND PROTECTION OF METALLIC OFFSHORE STRUCTURES	ING-IND/22	6
84188	DESIGN OF OFFSHORE STRUCTURES AND FOUNDATIONS	ICAR/09	9
75385	INTERNSHIP		6
81510	LABORATORY OF OFFSHORE OPERATIONS		6
78494	MODELLING OF OFFSHORE STRUCTURES	ICAR/08	6
81511	PROJECT MANAGEMENT IN OFFSHORE ACTIVITIES	ING-IND/35	6
78493	TURBOMACHINES AND POWER GENERATION FOR OFF-SHORE APPLICATIONS	ING-IND/08	3

Syllabus

Code	Aims and objectives	Course (alph. order)
73314	A successful learner from this course will be able to: a) deal with the most actual and urgent hydraulic and environmental problems connected with water supplies and drainage systems; design and operate urban water systems, taking into account: i) advanced design procedures and technological findings; ii) environmental and economic issues; and iii) construction site aspects; the b) apply basic modelling and computational techniques for addressing reliability analysis and risk assessment in civil engineering, with special emphasis on the water sector.	ADVANCED HYDROSYSTEMS ENGINEERING M
73315	Through this course the student acquires knowledge to integrate modern surveying technologies offered by Geomatics for the metrical study of objects, sites, and territory in a consistent way. The student learns the use of space-geodetic techniques suitable for multi-scale measurements (global to local), and thus he is able to integrate in situ observations, airborne surveying and satellite imagery. 3D data acquisition and modeling is in particular discussed, either for environmental applications and for civil and architectural surveys.	APPLIED GEOMATICS
78487	The course will provide students with the knowledge of biochemistry, microbiology and bioprocessing required for the sustainable remediation of impacted marine ecosystems (surface and subsurface water and sediments) and the industrial exploitation of marine biodiversity and bioresources.	BIOREMEDIATION AND EXPLOITATION OF MARINE BIORESOURCES
73355	To provide the students with the basics for understanding the roles of microbial populations in natural and contaminated habitats and with the main microbial and technological aspects related the conduction and optimization of the prominent environmental biotechnological processes currently applied in the remediation of industrial wastewaters, sediments and sites contaminated by xenobiotic compounds.	BIOTECHNOLOGY FOR THE SUSTAINABLE RECLAMATION OF CONTAMINATED LANDS
84188	The course aims to provide tools and skills for the design and management of coastal and ocean structures, as well as the assessment of their impact. The course will introduce and describe the processes that characterize the oceanic and coastal environment and will provide tools for the analysis and design of coastal defences, offshore structures, offshore and onshore approach facilities, and renewal energy plants. In particular the student will be able to analyze the sea conditions (waves, currents) and to design coastal and ocean structures, as well as harbors, breakwaters, offshore structures (TLP, offshore). Particular attention will be dedicated to environmental impact assessment. The conversion of energy from the sea (waves and currents) will also be treated.	COASTAL ENGINEERING

Code	Aims and objectives	Course (alph. order)
73371	The course is an introduction to computational mechanics of solids and structures. The goal of the course is to provide the students with the fundamental concepts and operating tools to solve current structural problems using computer technology.	COMPUTATIONAL MECHANICS
78642	The aim of the course is to introduce the student to the metallic materials used for off-shore installations and equipment. Knowledge on construction technologies, corrosion protection and materials for the protection from fire will also be provided.	CORROSION AND PROTECTION OF METALLIC OFFSHORE STRUCTURES
78491	The aim of the course is to provide for the basic and some advanced elements for design of offshore structures. After an extensive illustration of requirements and protocols for certification of steel for construction, the elements of design of steel structures will be given, including strength requirements, instability verification, design of connections (bolted and welded), with particular emphasis to those typical of off shore structures. Design criteria on more complex steel elements (tanks, pipes, plates,shell, etc) will be also given. Criteria for life extension of existing off shore platforms will be also given. Then, typologies of foundations for off shore structures will be illustrated, together with the design criteria for different kinds of grounds and loads to be transmitted.	DESIGN OF OFFSHORE STRUCTURES AND FOUNDATIONS
70002	The course is aimed at introducing the student at some individual activities which will continue in the second year with the preparation of the final dissertation: the organization of a complex and integrated project in the field of environmental engineering, or the state-of-art analysis of a research problem, selected at the beginning of the course.	ENVIRONMENTAL ENGINEERING RESEARCH A
70003	The course, initiated in the first year, continues with some individual activities concerning with the preparation of the final dissertation: the organization of a complex and integrated project in the field of environmental engineering, or the state-of-art analysis of a research problem, selected at the beginning of the course.	ENVIRONMENTAL ENGINEERING RESEARCH B
73358	The course is aimed at studying the engineering and environmental problems which may arise as a result of the interaction between geology and human activities. The main goal of the course is to improve the knowledge of geological and geomorphological processes, developing skills in the analysis of their effects on civil engineering design. On completion of this course, students will be able to: make preliminary site assessments on the basis of desk-study information; plan a programme of site investigation, selecting suitable invasive and non-invasive ground techniques; contribute to hydro-geological hazard assessment and to the development of measures for prevention and remediation of geological hazards.	GEOTECHNICS AND GEOLOGY

Code	Aims and objectives	Course (alph. order)
81645	The course aims at providing the students with the basic elements of loss prevention and process safety in the chemical and process industry, including oil&gas up-stream and down-stream. Fundamental notions on substance hazards and classification of hazardous substances are provided. The approach to the process of risk assessment and management is described. The framework for risk control, governance and mitigation is also provided. Special focus will be devoted to the environmental consequences of industrial accidents.	INDUSTRIAL AND ENVIRONMENTAL SAFETY M
73317	knowledge about the evolution of the environmental policy in EU. - knowledge about DPSIR model for the analysis and control of pollution process	INDUSTRIAL ECOLOGY M
75385	At the end of the internship, the student has acquired experience in close contact with one of the professional fields of possible future employment.	INTERNSHIP
73312	A successful learner from this course will be able to: a) deal with numerical analysis topics such as: accuracy, truncation and round-off errors, condition numbers, convergence, stability, curve-fitting, interpolation, numerical differentiation and integration, numerical linear algebra; b) deal with numerical methods for solving ordinary and partial differential equations, with finite difference and finite element methods for parabolic and elliptic partial differential equations, applications of computer programs to case studies derived from civil engineering practice.	INTRODUCTION TO NUMERICAL METHODS M
81944	Introduction to energy and environmental economics applied to markets and industries; Full understanding of the economical interaction between energy consumption and environment in particular concerning CO2 emission; Ability to economically evaluate the environmental damage, mainly from energy production; Comprehension of the different instruments to reach environmental targets; Understanding of the current Global and European environmental policy, first of all the Kyoto protocol; Economic analysis of different solutions to reduce greenhouse gas emissions.	LABORATORY OF ENVIRONMENTAL ENGINEERING AND ENERGY ECONOMICS
81510	The student will be introduced to the main construction and maintenance operations in off-shore activities with the aim of understanding the specificities required by off-shore operations.	LABORATORY OF OFFSHORE OPERATIONS

Code	Aims and objectives	Course (alph. order)
81644	Provide fundamentals about circular economy priorities and industrial opportunities and on the major waste streams and renewable and secondary feedstocks and on their current and potential industrial use as alternative resources to mitigate the current use of non-renewable, primary raw materials.	LABORATORY ON RENEWABLE RAW MATERIALS AND CIRCULAR ECONOMY
73370	A successful learner from this course will know the principles, methods and tools necessary to manage design and construction processes, elements of planning, estimating, scheduling, bidding and contractual relationships, valuation of project cash flows, critical path method, survey of construction procedures, cost control and effectiveness, field supervision.	MANAGING ENGINEERING AND CONSTRUCTION PROCESSES
73372	Knowledge of basic and advanced techniques for mechanical, thermal and morphological characterization of materials.	MATERIALS CHARACTERIZATION AND LABORATORY
73319	Students will acquire training that will be able to plan, direct, control open and underground mining and produce and/or examine properly technical documents in support of procedures of concessions to exploit mineral deposits.	MINERAL PRODUCTION SYSTEMS
78494	In the course, element for modelling ofoffshore structures will be given. Three main parts of the course will be: equivalent static and dynamic modelling of the actions, including wave action and wind, both in the time and frequency domains; finite element modelling of the structure, stress and displacement recovery and verifications; modelling and verifications against cyclic loadings, with special emphasis to fatigue and damage of metallic materials.	MODELLING OF OFFSHORE STRUCTURES
78640	This course provides theoretical and operatives knowledges concerning the monitoring and positioning aspects in the offshore engineering. In particular, different techniques for an accurate positioning based on GNSS technology will introduced both for monitoring of off-shore structures and for geolocalization of off-shore infrastructures. Examples of real applications regarding the monitoring or the positioning of offshore structures will be discussed.	MONITORING AND POSITIONING IN OFF-SHORE ENGINEERING
78486	The aim of the course is to provide specific knowledge on the Health, Environmental and Safety issues in off-shore operations, also focusing on those related to the production of Oil&Gas resources.	OFFSHORE HSE MANAGEMENT

Code	Aims and objectives	Course (alph. order)
78481	It consists of 2 integrated modules: TECHNOLOGIES FOR OFFSHORE O&G EXPLOITATION: The aim of the course is to introduce the student to the processes and technologies for the production of off-shore Oil&Gas resources. The student will gain knowledge on sub-sea, top-side and floating production technologies. EXPLOITATION OF OFFSHORE O&G RESOURCES: The learning outcome of this course is to provide the fundamental knowledge for the exploitation of hydrocarbon oil and gas off-shore reservoirs. In particular, geological, geophysical, drilling and production activities for a rational exploitation will be given.	OFFSHORE O&G EXPLOITATION I.C.
73362	The Course is addressed to provide the basic knowledge of petroleum systems and petroleum engineering, with special reference to exploration, drilling and production engineering. These topics represent strategic elements as far as world energy supply is concerned. The Course is completed with an introduction to the study of petroleum economics, project management and engineering phases of the petroleum industry, with applicative exercises and laboratory practices.	PETROLEUM GEOSYSTEM M
73366	The course founishes the knowledge both about the fundamentals of photocatalytic reaction and design of photocatalytic processes, and oboth about use of materials suitable for the photocatalytic application in environmental protection.	PHOTOCATALITIC PROCESSES AND ENVIRONMENTAL APPLICATIONS
73529	The course provides notions on the correlations between chemical, mechanical and thermal behaviour of macromolecules and their structure and microstructure. The complete life-cycle of polymeric material is analysed and discussed.	POLYMER SCIENCE, TECHNOLOGIES AND RECYCLING M
81511	The student will be introduced to the management of projects in the specific framework of the off-shore industry, with the aim of understanding the activities required to effectively manage a large-scale offshore project.	PROJECT MANAGEMENT IN OFFSHORE ACTIVITIES
78965	The aim of the course is to give a complete survey of the juridical and judicial landscape of the Italian and European systems in the topic of public procurement and contract.	PUBLIC PROCUREMENT
73356	To develop cultural, scientific and engineering aspects for the enhancement and sustainable use and recycling of both raw materials and primary-secondary resources. Moreover, they will be developed the design aspects and feasibility of Appropriate Technologies for the developing countries, particularly with regard to water supply, wastewater management and solid waste.	RESOURCES AND RECYCLING M

Code	Aims and objectives	Course (alph. order)
72748	Course overview, introduction to sustainability. Definitions, trends, measurements. Aspects on sustainability (environmental, economic, social). Environmental footprint of engineered systems, with emphasis on civil engineering (energy consumptions, CO2 emissions, etc). Performance-based design and life-cycle planning. The various aspects to be considered for sustainability in construction: material's production and transformation, management of construction process, occupancy (use costs energy and cost consumptions), occupancy (maintenance and durability issues), end-of-life costs, reuse/recycling. Life-cycle analysis (LCA): Cradle-to-grave analysis, LCA as a min-max problem. Mathematical tools required (Optimization techniques, multi-criteria decision making methods, simulation methods, statistics). Social Life Cycle Assessment (S-LCA) and Ecologically based LCA (Eco-LCA). Safety as a prerequisite. Energy efficiency in buildings. Renewable energy with emphasis to building applications (solar thermal and photovoltaic energy, geothermal energy). Protocols for rating systems for the design, construction and operation of high performance green buildings (LEED system, Ithaca).	SUSTAINABILITY IN CONSTRUCTION
81509	A successful student will know how roads are designed and built as well as learn about the construction materials and technologies either traditional and innovative. The approaches to evaluate the interaction and management of storm and ground waters through	SUSTAINABLE ROAD INFRASTRUCTURES
78493	The course is aimed at providing basic principles for design and operation of typical fluid machines used for island application in off-shore installations.	TURBOMACHINES AND POWER GENERATION FOR OFF-SHORE APPLICATIONS

Code	Aims and objectives	Course (alph. order)
78592	It consists of 2 integrated modules: FLOOD AND DROUGHT RISK MANAGEMENT: At the end of the course students have an understanding of the factors causing and aggravating both river floods and drougths, and a knowledge of the options and measures available for reducing and managing such risks. In particular, the course will provide advanced theoretical bases, knowledge of the tools and applied skills for (i) the assessment of flood and drought risk, in terms of hazard and vulnerability and (ii) the appraisal and design of measures for mitigating and managing such risks (such as structures for flood protection/mitigation, flood and drougths policies/plans/mapping; forecasting and managing flood and drougth emergencies). GROUNDWATER AND CONTAMINATION PROCESSES: The course provides fundamentals of subsurface flow and transport, emphasizing the primary role of groundwater in the hydrologic cycle, the relation of groundwater flow to hydrogeological properties, and the management of contaminated groundwater. Effective methods for the prediction and interpretation of groundwater processes will be discussed together with engineering implications. These include basics of infrastructure design related to the subsurface environment. Particular attention will be reserved to well hydraulics having several implications in water exploitation, monitoring and remediation. Description and analysis of both synthetic and real case studies will provide the opportunity to jointly apply concepts and methods discussed during the course.	WATER ENGINEERING I.C.